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A Review of *Hapalogenys*, a Genus of Perch-like Fishes, from Japan and Adjacent Region.[1]

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The present paper, in which is given a review of the species of grunts belonging to the genus *Hapalogenys*, is based on material collected from southern China Sea, Tyôsen, Misaki, Tokyo Bay, and also from Tokyo fish-market. Of six species, to which the specimens are refered, one is proposed here to be new.

The present author fully acknowledges his indebtedness to Professor A. Terao for his kind supervision. He is also much obliged to Dr. S. Tanaka for a loan of literatures, to Dr. Y. Wakiya for valuable advices in the identification, and to Mr. Y. Hiyama for supplying some material to him.

The body length is measured from tip of snout to the last pored scale on the lateral line, and the head from tip of snout to postrior end of opercle. The length of snout is represented by the horizontal distance between the tip of snout and vertical drawn from the anterior margin of orbit. This length is also obliquely measured from the tip of snout to the anterior margin of orbit. The measurement in parentheses refers to that by the second method.

A new item, *facial angle*, is introduced in the present report since this angle is nearly invariable in each species irrespective of age of specimens. It is measured, as illustrated in Fig. 1, by the intersecting angle of two

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lines, one drawn horizontally from upper margin of premaxillary to lower end of caudal peduncle and the other tangential to upper profile of head.

Genus *Hapalogenys* Richardson.

Hapalogenys Richardson, 1844, p. 463; Jordan & Thompson, 1912, p. 55.

Type:—*Hapalogenys nitens* Richardson.

Body high, compressed, dorsal profile elevated, covered with ctenoid scales. Leteral line arched. Mouth horizontal; teeth rough, crowded, stouter

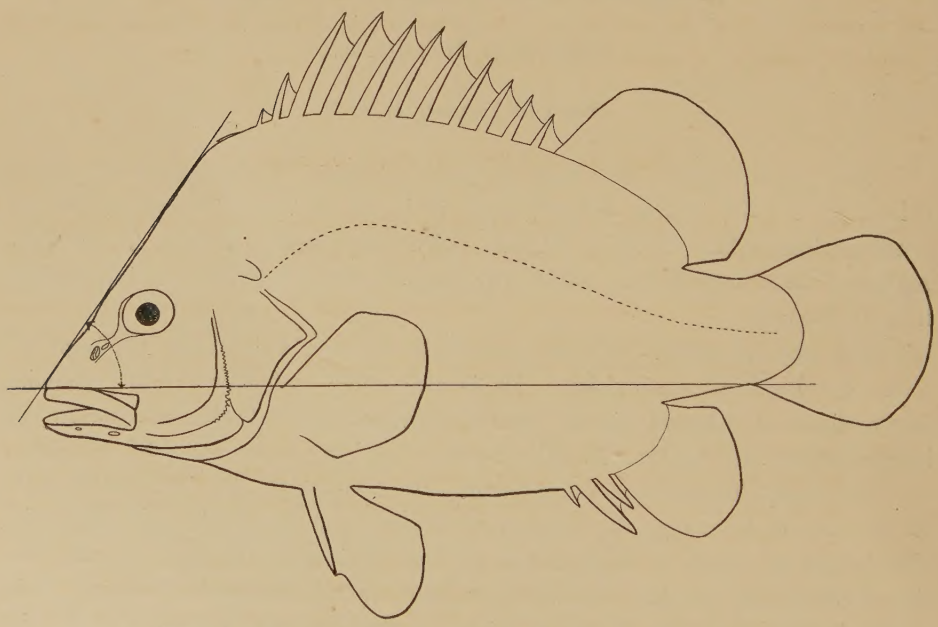

Fig. 1. Diagram showing method of measuring facial angle.

in outer series, but no true canines in front teeth; palatine smooth, folded. Lower jaw and chin crowded with dermal papillae; chin with several pores. No central groove under the chin. Tip of snout naked with rudimentary papillae.

Preoperculum serrated. Operculum with two small spines. One dorsal, with eleven strong spines and an antrorse spine before it. Small scales cover

the lower fronts of the dorsal spines on alternate sides of the membrane. Soft part of vertical fins scaled at bases, and membranous parts between the rays also scaled. Caudal rounded or concave. Branchiostegal membranes are supported by six rays. Air bladder simple.

The genus differs from the other genera of Haemulidae in the following points: dorsal preceded by an antrorse spine; jaws and chin with dermal papillae; and several pores are present on chin and throat.

The types of this genus inhabit warm parts of Asia, northward to Tokyo.

This genus contains besides six species dealt with in this paper two more ones, *H. meyenii* from Manila and *H. petersi* from India, which are characterized by having 18–19 dorsal rays and having posterior margin of caudal fin concave. The six species, on the other hand, have 14–16 dorsal rays and posterior margin of caudal fin rounded.

Key to species of *Hapalogenys*.

a. Third dorsal spine shorter or subequal to fourth dorsal spine; opercular spines rudimentary, entirely hidden in the skin, margin of vertical fins pale; body marked with oblique or longitudinal bands.

b. Barbels of chin and premaxillary rudimentary; maxillary without scales but covered with small rudimentary barbels; second anal spine very long, about half the length of head; nostrils relatively large, much nearer to front of orbit than to tip of snout; orbit very large, longer than one-fourth the length of head; body marked with four longitudinal bands ... ... *kishinouyei*, 1.

bb. Barbels of chin well developed except *H. nitens* Richardson; second anal spine much shorter than half the length of head; nostrils moderate, a little nearer to eye than to tip of snout; eye moderate, smaller than one-fourth the length of head; body marked with oblique bands.

c. Maxillary without scales; scales very large, the largest one about 0.65 times of orbit, 17 in number from origin of anal fin to lateral line; ventral fin very long, nearly reaches to vent; three pairs of very small pores on chin, and one slit-like pair on throat ... ... *nigripinnis*, 2.

cc. Maxillary with scales; scales relatively small, the largest one much shorter than one-half the length of orbit, 24 or 25 in number from origin of anal to lateral line; ventral not reaching to the vent; chin with four pairs of pores and one pair on throat.

d. Orbit small, about 5 in head and much shorter than width of preorbital; posterior margin of preopercle vertical, not gradually convex towards its angle; teeth of jaws rather small, not canine-like; snout long and pointed, about 3.25 (but about 2.4 when snout measured in oblique length) in head, its upper profile not steep, facial angle about 51° to 55°; barbels of chin

rudimentary; second anal spine short, about 3.2 in head; fourth dorsal spine short, equal to the length of third or fifth dorsal spine, 2.16 in head; ventral rather short, reaches, when depressed, a half way from origin of ventral to second or third anal ray ... ... *nitens*, 3.

dd. Orbit rather large, 4.5 in head; posterior margin of preoperculum convex towards its angle; the outer teeth of jaws large and front ones somewhat canine-like; snout rather blunt, the upper profile of snout very steep; facial angle 65° to 72°. Barbels of chin rather long and remarkable. Fourth dorsal spine longer than third or fifth dorsal spine.

e. Second anal spine very long, much longer than one-half the fourth dorsal spine, 2.6 in head and 1.7 times of orbit; fourth dorsal spine long, 1.7 in head; snout very steep, facial angle about 72°; ventral long, extends when depressed, to a half way from origin of ventral to basal end of anal ... ... *maculatus*, 4.

ee. Second anal spine short, rather more than one-half the fourth dorsal spine and 3.6 in head; fourth dorsal spine short, about 2.0 in head; snout not steep, facial angle 65°; ventral rather short, reaches when depressed a half-way from origin of ventral to base of middle anal ray ... ... *Güntheri*, 5.

aa. Third dorsal spine very long, much longer than fourth spine; two opercular spines prominent in adult specimens, but entirely hidden in small ones as in grown-up specimens of other species; the barbels of chin remarkable; soft dorsal, anal and caudal fins each narrowly edged with black; body marked with five dark cross bands; peritoneum black ... ... *mucronatus*, 6.

1. *Hapalogenys kishinouyei* Smith and Pope.

Japanese Name: Sima-setodai.

Hapalogenys kishinouyei Smith and Pope, 1906, p. 476, fig. 6 (Urado); Jordan and Thompson, 1912, p. 554, fig. 3 (Urado); Fowler, 1931, p. 269.

Hapalogenys nigripinnis (pars) Jordan, Tanaka and Snyder, 1913, p. 170 (Urado); Jordan and Hubbs, 1925, p. 239.

Hapalogenys nigripinnis Schmidt, 1931, p. 66 (Nagasaki).

Head 2.98 in body length; depth 2.17; orbit 4.0 in head; snout 3.75 (2.65); maxillary 2.68; preorbital width 5.4; interorbital space 3.46; first dorsal spine 9.75; second spine 4.18; third spine 2.27; fourth spine 1.71; pectoral 1.42; ventral 1.28; caudal 1.50; second anal spine 2.13; depth of caudal peduncle 2.6. D. XI, 14; A. III, 9; scales on lateral line 47, in transverse series between insertion of dorsal and anal $^{10}/_{22}$. Gill-rakers on first arch 7+11, the first one on lower limb the longest, about 4 in orbit.

Body deep; dorsal profile of head not steep but straight from snout to

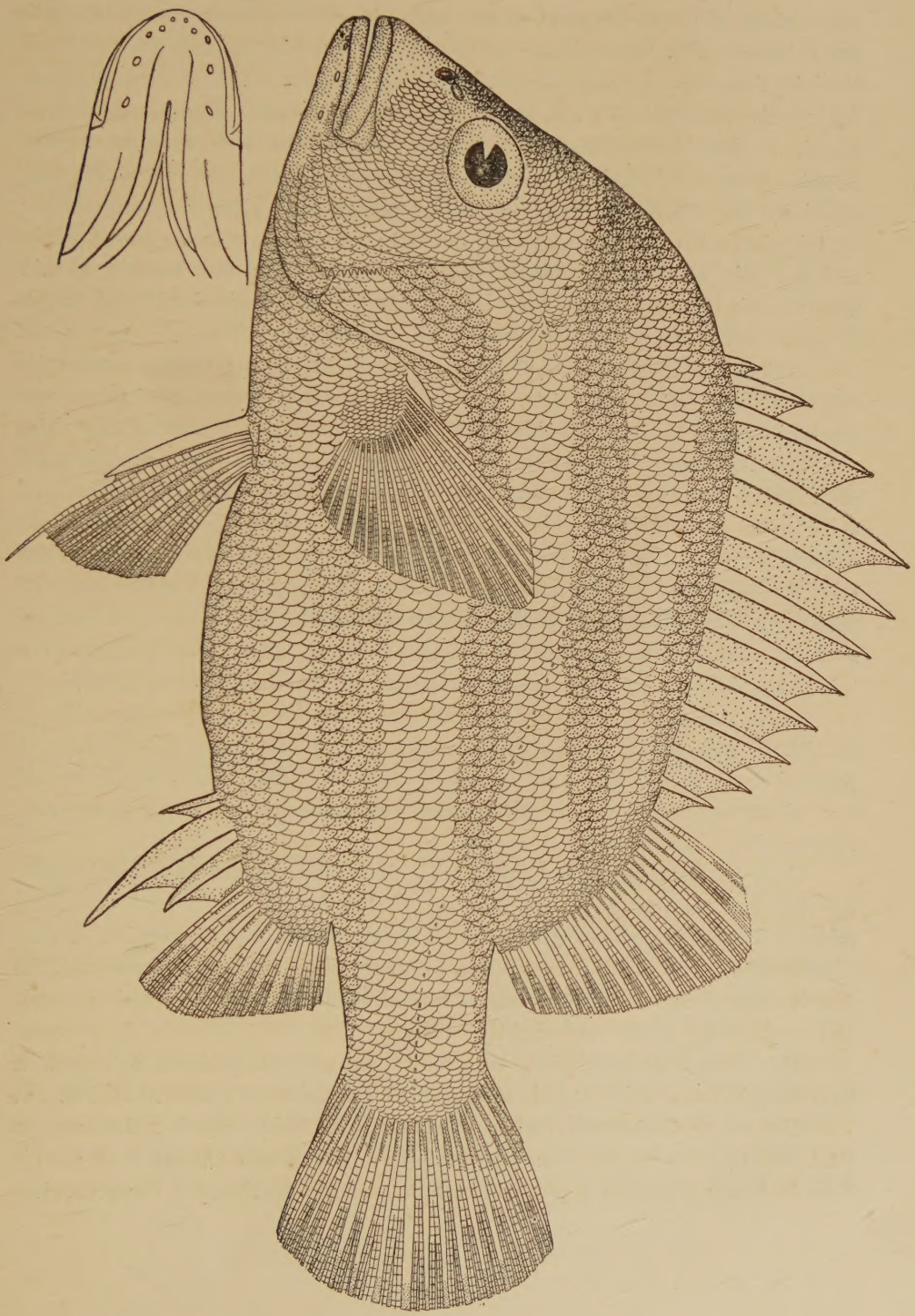

Fig. 2. *Hapalogenys kishinouyei* Smith and Pope. $\times\frac{3}{4}$.

nape which is gently arched; facial angle about 55°; back nearly straight from initial of spinous dorsal to that of soft dorsal; ventral profile almost straight from tip of lower jaw to insertion of anal fin. Mouth low, horizontal, nearly parallel with the ventral outline; snout rather blunt, its horizontal length a little longer than diameter of orbit; maxillary reaching beyond anterior margin of pupil; jaws with villiform teeth, the outer teeth enlarged, especially the anterior teeth of upper jaw strong and somewhat canine-like; symphysial notch of upper jaw not evident; four pairs of large pores on chin and one pair on throat, pores not hidden by the skin; the barbels of chin nearly rudimentary. Orbit very large, nearly equal to the horizontal length of snout and much larger than width of preorbital.

Posterior margin of preoperculum vertical, not gently convex towards its angle, armed with very strong denticulations, especially the angular ones coarser; opercle with two feeble spines, which are entirely hidden in the skin.

Dorsals deeply divided; the fourth dorsal spine much longer and stronger than third one, the fifth spine slightly shorter than fourth one, the tenth spine equal to the diameter of orbit; an evident procumbent spine present anteriorly; the outline of spinous dorsal straight from the fourth spine to last one; the third ray of soft dorsal the longest, 2.3 in head. Ventral long, the outer ray filamentous, its double length extends beyond the end of base of anal fin. Anal spines strong, the second one much longer and stronger than third one, 2.13 in head and about twice as long as the diameter of orbit.

Scales rather large lacking anterad from nostrils, absent on premaxillary, maxillary and lower jaw; minute scales present at bases of soft rays of pectoral and vertical fins, and a minute row extending along each side of rays about one-fourth to one-fifth of the way to their tips; large sheath also present along base of spinous dorsal.

Color in formalin dark brown, with four faintly black horizontal bands, the first one running along the base of spinous dorsal, the second one from midway between origin of spinous dorsal and eye to middle portion of base of soft dorsal, the third from opercle to upper end of caudal peduncle, the fourth from pectoral to lower end of caudal peduncle; spinous dorsal, ventral, and anal dusky, other fins slightly dusky.

The foregoing description is based upon a male specimen 248 mm. in total length from Tokyo market; Imperial Fisheries Institute Mus. No. 23.

The measurements of another specimen from Tokyo market, 183 mm in total length, are as follows: head 2.74 in body length; depth 2.04; orbit 3.86 in head; snout 3.52 (2.95 in oblique length); maxillary 2.70; preorbital

width 5.71 ; interorbital space 4.0 ; first dorsal spine 6.22 ; second spine 3.30; third spine 2.03 ; fourth spine 1.72 ; pectoral 1.59, ventral 1.49 ; caudal 1.52; second anal spine 2.23 ; depth of caudal peduncle 2.80. D. XI, 14 ; A. III, 9 ; scales on lateral line 47, in transverse series between beginning of spinous dorsal and anal $^{10}/_{21}$. Gill-rakers on first arch 8+10, the eighth one on upper limb the longest. In this specimen the orbit somewhat longer, body deeper and first and second dorsal spines a little longer than in the first specimen.

My two specimens (248 and 183 mm.) agree with the one small specimen (115 mm.) described by Smith and Pope in having long anal spines, rudimentary barbels on chin, and markings, but slightly differ from it in somewhat smaller eye, longer snout and wider preorbital bone. These discrepancies, however, are apparently due to smaller size of his specimen since my younger one stands intermediate between the type and my older one in these respects.

Jordan and Hubbs (1925, P. 239) regarded this species as a young form of *H. nigripinnis* T. & S. But there is no room for doubt that it is distinct from *H. nigripinnis* and the others in the followihg particulars : second anal spine very long, about half the length of head ; maxillary without scales ; the barbels rudimintary ; eye large ; body with four dark longitudinal bands and nostrils much nearer to orbit than to tip of snout.

Habitat.—Inland Sea of southern Japan.

2. *Hapalogenys nigripinnis* (Temminck and Schlegel).

Japanese Name : Higedai.

Pogonias nigripinnis Temminck and Schlegel, 1843, p. 59, pl. XXV (Nagasaki).
Hapalogenys nigripinnis Tanaka, 1914, p. 282, pl. LXXVIII, fig. 269 (Tokyo market).

Head 2.85 in body length ; depth 2.01 ; orbit 5.19 in head ; snout 2.91 (2.38 in oblique length) ; maxillary 2.50 ; preorbital width 4.37 ; interorbital space 4.67 ; first dorsal spine 8.75 ; second spine 4.1 ; third spine 2.19 ; fourth spine 1 84 ; pectoral 1.59 ; ventral 1.37 ; caudal 1.44 ; second anal spine 2.48 ; depth of caudal peduncle 2.49. D. XI, 16; A. III, 10; scales on lateral line 47, in transverse series between insertion of dorsal and anal $^{9}/_{17}$. Gill-rakers on first arch 6+13, the first one on lower limb the longest, about 3 in orbit.

Body deep, the upper profile of head not steep, concave before eyes, the nape rather strongly arched, facial angle 55° ; ventral profile nearly

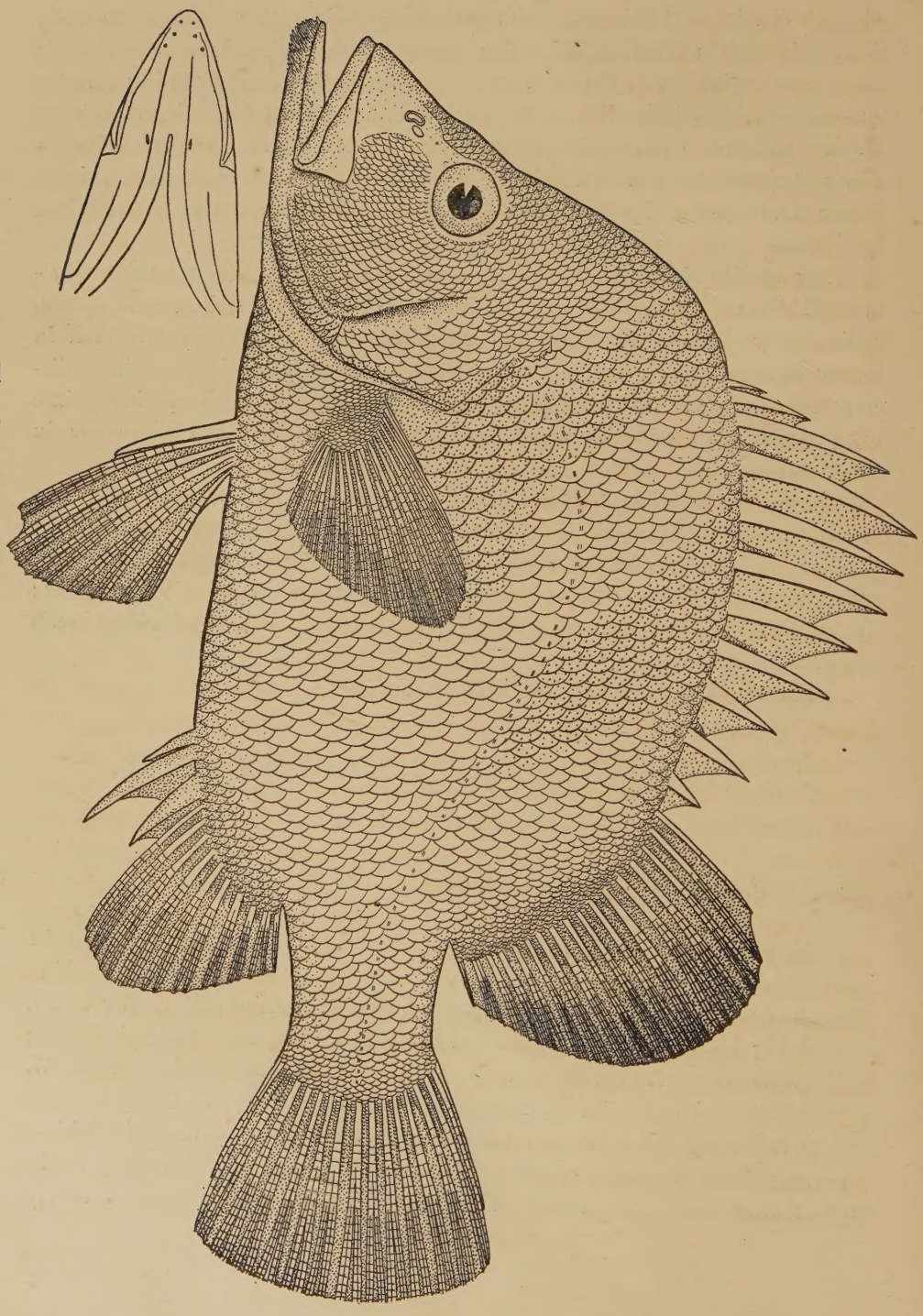

Fig. 3 *Hapalogenys nigripinnis* (Temminck and Schlegel). ×$\frac{3}{4}$.

straight from tip of lower jaw to insertion of anal. Mouth low, horizontal; snout long and pointed, its horizontal length about twice as long as oribit; lower jaw a little longer than upper. Maxillary reaching to under anterior margin of pupil; jaws with villiform teeth, the outer teeth enlarged, but not canine-like; symphysial notch of upper jaw evident; three pairs of rudimentary pores on chin and a slit-like one on throat, the former ones entirely hidden by crowded long barbels; the barbels of chin extremely enlarged, the largest one a little more than one-fourth the length of orbit. Orbit very small, shorter than the depth of preorbital. Posterior margin of preoperculum nearly vertical, slightly convex towards its angle, armed with very small and numerous serrations; two opercular spines present, but very feeble and entirely hidden in the skin.

Dorsals deeply divided; the fourth spine the longest, somewhat longer than third or fifth spine, these two nearly equal in length; procumbent spine distinct, just equal to the length of first dorsal spine; the outline of spinous dorsal straight from the fourth spine to the last one; the fourth ray of soft dorsal the longest, 1.89 in head. Ventral extremely long, its outer ray not filamentous, reaching to vent, its double length extending nearly to the middle portion of caudal peduncle. Anal spines long and strong, the second spine much longer than third, slightly longer than twice the length of orbit.

Scales extremely large, the largest one much longer than one-half the length of orbit; scales absent anterad from nostrils, none on maxillary, premaxillary and lower jaw; minute scales present at bases of pectoral and soft vertical fins; minute rows also extending along each side of rays about one-half or one-third of the way to their tips; a sheath also present along base of spinous dorsal and a row of minute scales extending the front of the dorsal spine on alternate sides of the membrane.

Color in formalin grayish black, with two very faint oblique bands; the first from base of fourth and seventh dorsal spines to upper part of caudal peduncle; the second parallel with the first from occiput, down to behind the base of pectoral fin; all the fins black, especially the ventrals jet black.

The foregoing description is based upon a male specimen 243 mm. in total length from Toky fish market; Imperial Fisheries Institude Mus. No. 24.

It is worth while to mention that *Hapalogenys nigripinnis* is shown in Temminck and Schlegel's figure (1843, pl. 25) to have the dorsal spines, ventrals and anal spines much shorter than those of my specimen.

I am inclined to regard these discrepancies as draughtsman's errors. Even if such discrepancies be real, my specimen should be refered to the present species since agreements in having extremely large scales, long barbels on chin, small eyes and concave upper profile of head before eye are beyond doubt. It may be mentioned that my specimen quite agrees with *Hapalogenys nigripinnis* as shown in Tanaka's figure and description (1914, p. 282, fig. 269) in all respects.

This species can be easily distinguished from the others in the following points: scales very large, the largest one much more than one-half the length of orbit and 17 in number from insertion of anal fin to lateral line; barbels very long, the longest one more than one-fourth the length of orbit; the pores on chin very small and fewer in number; maxillary without scales; the serrations of preopercle numerous and small; lower jaw somewhat projecting beyond the upper; upper profile of snout evenly concave; snout very long, pointed; ventrals very long, reaching to vent; the antrorse spine before dorsal very small, just equal to the length of first dorsal spine.

Habitat.—Tokyo to Nagasaki.

3. *Hapalogenys nitens* Richardson.

New Japanese Name: Higesoridai.

Hapalogenys nitens Richardson, 1884, p. 436 (Canton) and 1886 (b), p. 84, pl. 43, figs. 1–2 (China Seas, Macao).

Hapalogenys nigripinnis Steindachner, 1896, p. 198 (Kôbe, Nagasaki); ? Franz, 1910, p. 46 (Aburatubo).

Hapalogenis nigripinnis Steindachner and Döderlein, 1883, p. 10 (Tokyo).

Head 2.78 in body length; depth 1.95; orbit 5.1 in head; snout 3.20 (2.41 in oblique length), maxillary 2.70; preorbital width 4.38; interorbital space 4.07; first dorsal spine 11.0; second spine 4.93; third spine 2.17; fourth spine 2.17; ventral 1.62; caudal 1.62; second anal spine 3.22; depth of caudal peduncle 2.43. D. XI, 15; A. III, 9; scales in lateral line 52, in transverse series between insertion of dorsal and anal $^{12}/_{25}$. Gill-rakers on first arch 8+12, the eighth one on upper limb the longest, 2 in orbit.

Body deep and compressed, dorsal profile not steep but nearly straight, slightly concave before eye from snout to recumbent spine of dorsal, the nape strongly arched; facial angle about 55°; back and ventral profiles gently curved. Mouth low and horizontal; snout pointed, its length much

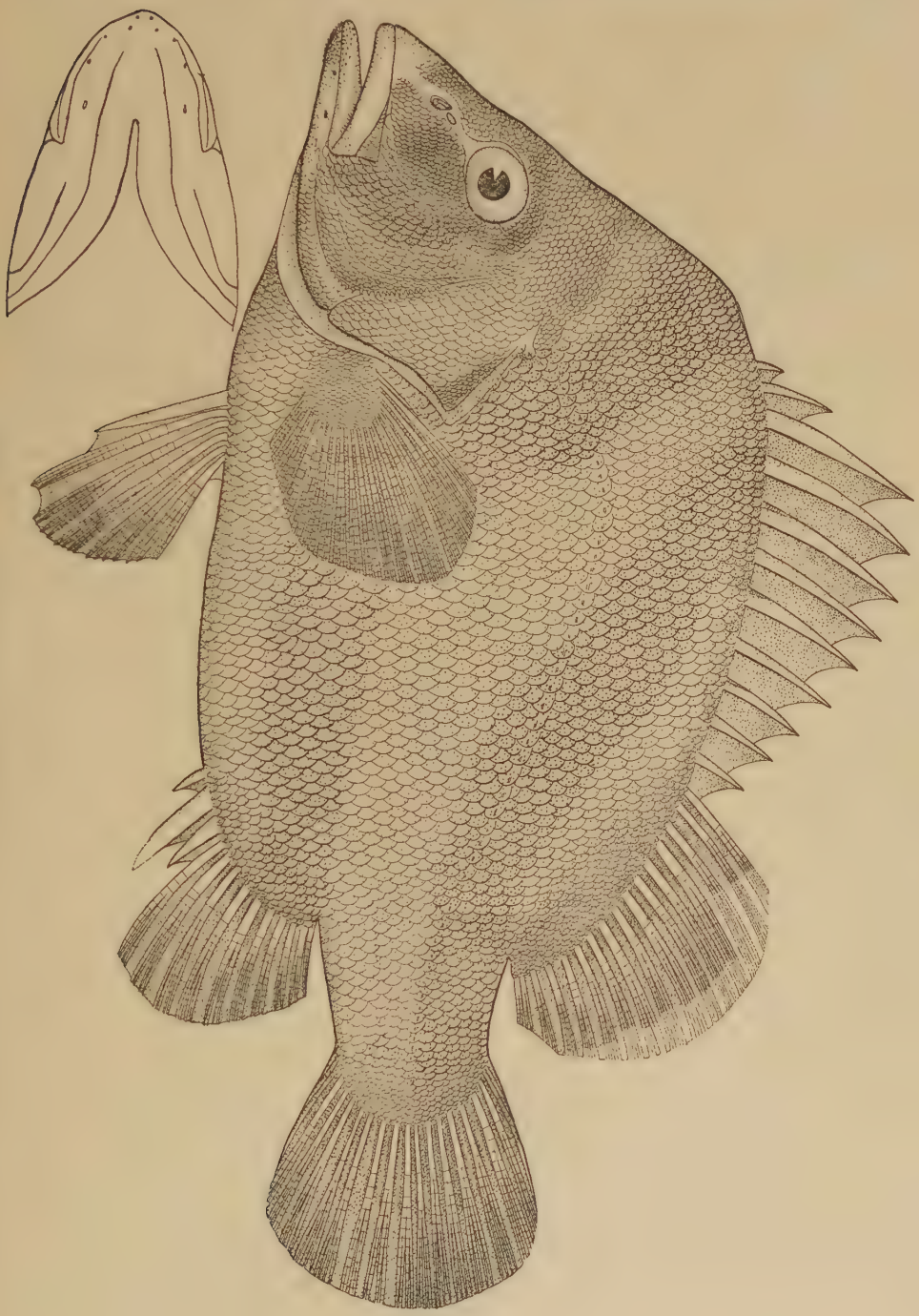

Fig. 4. *Hapalogenys nitens* Richardson. ×$\frac{3}{4}$.

longer than orbit, 1.54 times (2.21 in obbique length) of latter; maxillary reaching beyond anterior margin of pupil; jaws with villiform teeth, the outer row somewhat enlarged, but not canine-like; symphysial notch of upper jaw evident; the pores not evident, hidden by the skin, four pairs of very small ones on chin and a large slit-like one on throat; the barbels of chin rudimentary. Orbit very small, much shorter than width of preorbital; posterior margin of preopercle vertical, not gently convex towards its angle, armed with rather strong denticulations.

The third and fourth dorsal spines short, quite equal in length, much shorter than one-half the length of head, the outer profile of spinous dorsal slightly convex from fourth to last spine; a procumbent spine before dorsal nearly embedded in the skin; ventral short, its outer ray not elongated as a filament, its double length only extends to base of second or third anal ray. Anal spine short, the second spine much shorter than one-third the length of head, and 1.55 times of orbit.

Scales rather smaller than in other species of *Hapalogenys*, lacking on tip of snout, premaxillary and lower jaw, replaced by rudimentary papillate barbels; minute scales present on exposed area of maxillary, bases of pectoral and soft portion of vertical fins; the minute rows of scales extending along each side of rays about one-fifth or one-third of the way to their tips.

Color in formalin grayish black, marked with two rather faint oblique bands; the first from the base of anterior half of the spinous dorsal to the upper part of caudal peduncle; the second parallel with the first from nuchal region, down through the area behind pectoral and back to the base of posterior half of the anal fin; preorbital region, tip of opercle and membranes of all fins black, especially ventrals and anal darker; mouth, gill cavities and peritoneum pale.

The above description is based upon a female specimen 235 mm. in total length from Huzan market; Imperial Fisheries Institute Mus. No. 25.

The proportions of the different parts of the body of other two specimens slightly vary as follows:—

TABLE I.

Specimen No.	1	2
Lacality	Huzan	Huzan
Sex	♂	♀
Total length	224.2mm.	223.5mm.
Depth in body length	2.00	2.00
Head in body length	2.85	2 83
Second anal spine in head	?	3.22
Orbit in head	4.91	5.00
Snout in head	3.06	3.06
Oblique length of snout in head	2.46	2.30
Interorbital space in head	3.67	3.85
First dorsal spine in head	9.46	9.89
Second spine in head	?	3.57
Third spine in head	?	2.10
Fouth spine in head	2.01	2.01
Ventral in head	1.67	1.62
Pectoral in head	1.62	?
Facial angle	51°	53°

As shown above, in these two there are no remarkable variations, except snout, first and fourth dorsal spines slightly longer and interorbital space somewhat wider than the described specimen.

The species can be distinctly separated from the others in the following points: orbit very small, not longer than one-fifth the length of head; snout long, 3.06 to 3.20 (2.30 to 2.46 in oblique length) in head; fourth dorsal and second anal spines very short; the posterior margin of preoperculum vertical, not convex towards its angel; facial angle about 51° to 55°.

Habitat.—Southern Japan north to Tokyo, and Tyôsen.

4. *Hapalogenys maculatus* Richardson.

New Japanese Name: Nirami-Higedai.

Hapalogenys maculatus Richardson, 1846 (a), p. 235 (China Sea, Canton); Bleeker, 1857, p. 65 (Nagasaki).

Head 2.81 in body length; depth 1.92; orbit 4.48 in head; snout 3.75 (2.44 in oblique length); maxillary 2.61; preorbital width 4.35; interorbital space 4.07; first dorsal spine 9.70; second spine 3.75; third spine 1.91; fourth spine 1.70; pectoral 1.71; ventral 1.51; caudal 1.42; second anal spine 2.60; depth of caudal peduncle 2.66. D. XI, 15; A. III, 9; pored scales on lateral line 50, in transverse series between insertion of dorsal and anal $^{10}/_{24}$. Gill-rakers on first arch 7+12, the seventh one on upper limb the longest, about 2.5 in orbit.

Body very deep and the upper profile of head extremely steep, acute and nearly straight from tip of snout to supraorbital region nape strongly arched and acute; facial angle 72°; back gradually descending to the end of base of soft dorsal; ventral profile nearly straight from tip of lower jaw to insertion of anal fin; mouth low and horizontal, parallel with ventral profile; snout very blunt and short, its length slightly longer than diameter of orbit, 1.17 times of latter (but 1.80 times when snout measured obliquely); maxillary extending to under middle of pupil; jaws with villiform teeth, the outer teeth enlarged, especially the anterior teeth of upper jaw strong and somewhat canine-like; symphysial notch of upper jaw evident; four pairs of rather large pores on chin and a large slit-like one on throat; all these pores somewhat covered by barbels; the papillae of chin and edge of the lower jaw moderate. Orbit very large, just equal to the width of

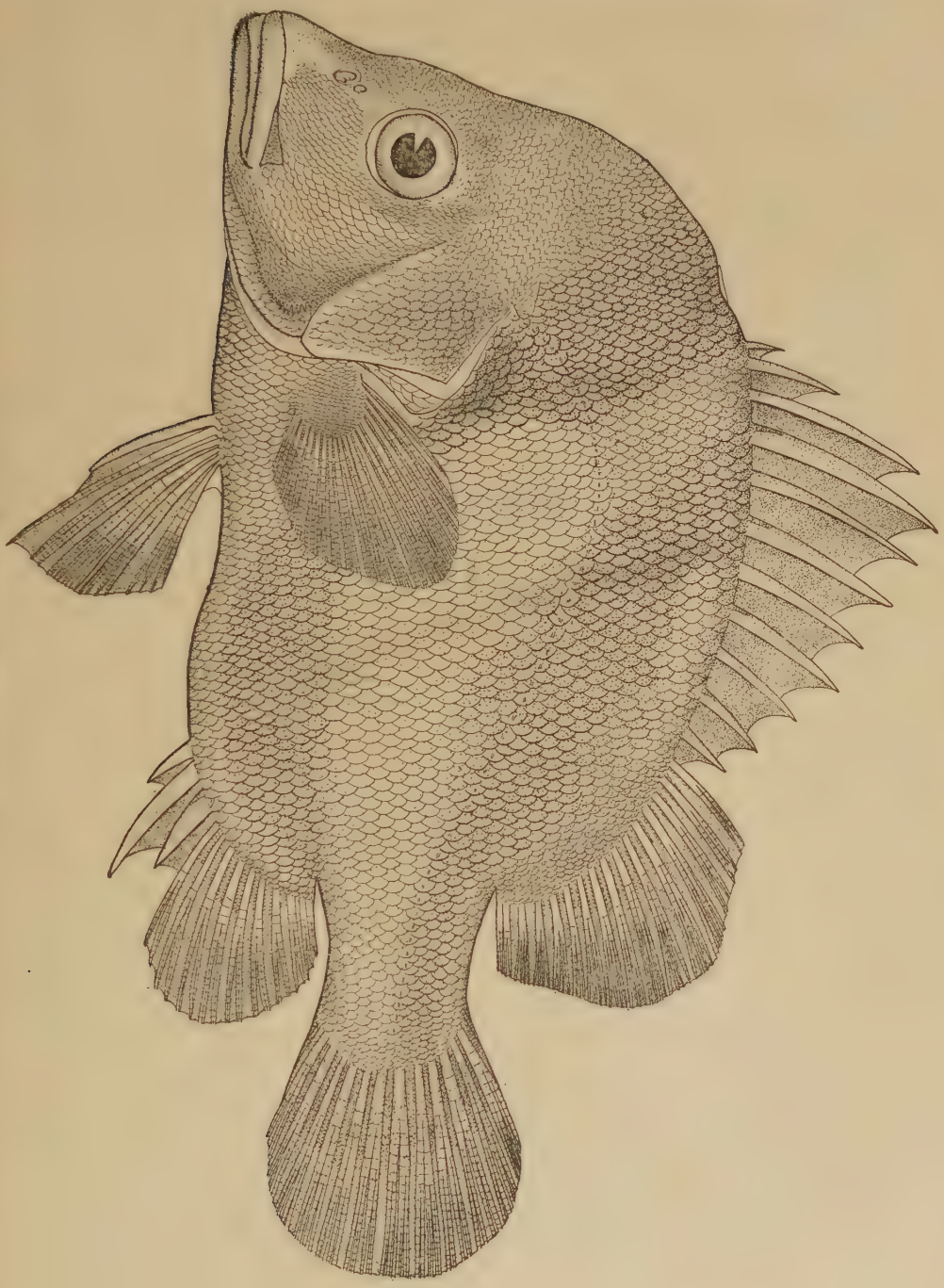

Fig. 5. *Hapalogenys mucronatus* Richardson. ×$\frac{3}{4}$.

preorbital and slightly shorter than horizontal length of snout; posterior margin of preoperculum convex towards its angle, armed with rather strong denticulations.

The fourth dorsal spine longer and stronger than third one, much longer than one-half the length of head; the tenth spine just equal to the length of orbit; an evident procumbent spine present before dorsal; the outline of spinous dorsal slightly convex from the fourth to last spine; the fifth ray of soft dorsal the longest, 2.11 in head; ventral very long, its outer ray somewhat filamentous, its double length extending beyond the end of base of anal fin. Anal spine strong, the second one much longer than third, much longer than one-third the length of head and about 1.7 times of orbit.

Scales moderate, lacking on tip of snout, and absent on premaxillary, lower jaw and chin, replaced by moderate barbels, upper jaw less coarsely papillose; minute scales present on exposed area of maxillary, and also present at the base of pectoral and soft vertical fin; and a minute row extending along each side of rays one-fifth to one-half of the way to their tips; a sheath also present along base of spinous dorsal and a row of minute scales extending the fronts of the dorsal spines on alternate sides of the membrane.

Color in formalin blackish gray, marked with two rather faint oblique bands as in *H. nitens* Richardson; all fins blackish.

The above description is based upon a female specimen 234 mm. in total length from Tokyo fish market, probably from China Sea; Imperial Fisheries Institute Mus. No. 26.

The measurements of another specimen from Tokyo market (probably from southern China Sea), which is a small female specimen 171.0 mm. in total length, are as follows: head 2.67 in body length; depth 1.85; orbit 4.30 in head; snout 3.20 (but 2.53 in oblique length); maxillary 2.46; preorbital width 4.59; interorbital space 4.60; first dorsal spine 7.80; third spine 1.94; fourth spine 1.87; longest dorsal ray (fifth ray) 2.10; pectoral 1.63; ventral 1.52; caudal 1.40; second anal spine 2.73; depth of caudal peduncle 2.62. D. XI, 16; A. III, 9; scales on lateral line 48, in transverse series between insertion of dorsal and anal $^{11}/_{24}$. Gill-rakers on first arch 7+12, the seventh one on lower limb the longest, 2.9 in orbit; facial angle 67°.

My specimens quite agree with *H. maculatus* described by Richardson (1846, p. 235) in having acute nape and very long second anal spine.

From *H. nitens* Richardson this species is distinguished in the following points: orbit very large, about 4.5 in head; posterior margin of preoperculum

convex towards its angle; snout very blunt and short; upper profile of head very steep, approaching the vertical; anterior teeth of upper jaw canine-like; fourth dorsal spine much longer than third spine, 1.7 in head; second anal spine very long, 2.6 in head and ventral very long, its double length reaching beyond the end of base of anal fin.

Habitat.—Southern Japan and China Sea.

5. *Hapalogenys güntheri*, sp. nov.

New Japanese Name: Günther-higedai.

Hapalogenys nigripinnis Günter, 1859; p. 317 Chinese Seas); Jordan and Thompson, 1912, p. 551 (Wakanoura and Turuga).

Head 2.83 in body length; depth 2.00; orbit 4.55 in head; snout 3.5 (but 2.21 when snout measured in oblique length); maxillary 2.57; preorbital width 3.84; interorbital space 3.89; first dorsal spine 8.15; second spine 4.00; third spine 2.26; fourth spine 2.08; pectoral 1.69; ventral 1.52; caudal 1.53; second anal spine 3.60; depth of caudal peduncle 2.57. D. XI. 15; A. III. 10; scales on lateral line 52, in transverse series between insertion of dorsal and anal $\frac{12}{25}$. Gill-rakers on first arch 7 + 12, the seventh one on lower limb the longest, 2.75 in orbit.

Body deep and compressed, upper profile of head rather steep, slightly convex before eye, strongly arched at nape, facial angle about 65°; back and belly gently curved. Mouth low and horizontal; snout blunt and rather short; maxillary extending to under the middle part of pupil; the teeth of jaws strong, the anterior teeth somewhat canine-like; symphysial notch of both jaws remarkable; four pairs of rather large pores on chin and a large slit-like one on throat, these pores partly hidden by the long barbels of chin; orbit very large, much longer than one-fifth the length of head and slightly shorter than width of preorbital; posterior margin of preoperculum gradually convex towards its angle, armed with rather small denticulations.

Fourth dorsal spine longer than third, shorter than one-half the length of head; an evident procumbent spine present before dorsal; the outline of spinous dorsal somewhat convex; anal spines short, the second one much shorter than one-third the length of head; ventral moderate, its outer ray slightly filamentous, its double length reaches to middle portion of base of soft anal.

Scales moderate, lacking on anterior edge of snout, premaxillary, mandible

Fig. 6. *Hypalogenys günther*, sp. nov. $\times \frac{2}{3}$.

and chin, replaced by rather conspicuous barbels, upper jaw less coarsely papillose; exposed area of maxillary covered with small scales; minute scales present at bases of soft dorsal, anal, pectoral and caudal; and minute rows extending along each side of rays about one-half to two-thirds of the way to their tips; a row of minute scales extending the fronts of the dorsal spines on alternate sides of the membrane.

Color in formalin brown, marked with two oblique dark bands as in *H. nitens* Richardson; all the fins somewhat blackish.

The above description is based upon a male specimen 257.5 mm. in total length from Huzan, Tyôsen; Imperial Fisheries Institute Mus. No. 27.

The measurements of another small male specimen 179.0 mm. in total length from the same locality are as follows: head 2.83 in body length; depth 2.00; orbit 4.23 in head; snout 3.36 (2.58 in oblique length); maxillary 2.72; preorbital width 4.2; interorbital space 4.59; first dorsal spine 9.33; second spine 3.94; third spine 2.17; fourth spine 1.80; pectoral 1.53; ventral 1.83; caudal 1.44; second anal spine 3.07; depth of caudal peduncle 2.55. D. XI, 15; A. III, 10; scales on lateral line 46, in transverse series between insertion of dorsal to anal $^{12}/_{25}$. Gill-rakers on first arch 7+12, the seventh one on upper limb the longest, 2.72 in orbit. The facial angle 65°; the posterior margin of preoperculum gradually convex towards its angle.

As shown above, the second smaller specimen somewhat differs from the first larger one in having longer second anal and first dorsal spine, and narrower interorbital space, but quite agrees with it in the facial angle and in having the preoperculum gradually convex towards its angle. The differences between these two specimens are evidently due to the size of specimens.

It is worth mentioning that *H. nigripinnis* described by Jordan and Thompson (1912, p. 551) agrees with the specimens at my disposal in having the short second anal spine, 4 in head, fourth dorsal spine short, 2 in head, snout blunt and rounded and preopercular angle produced somewhat backward.

The present species differs from *H. maculatus* in the following points: fourth dorsal spine very short, about 2 in head; second anal spine short, much shorter than one-third the length of head; snout not so steep, the facial angle about 65° instead of 72°; the ventral moderate, its double length reaching to middle of base of soft anal.

Habitat.—Southern Japan and China Sea.

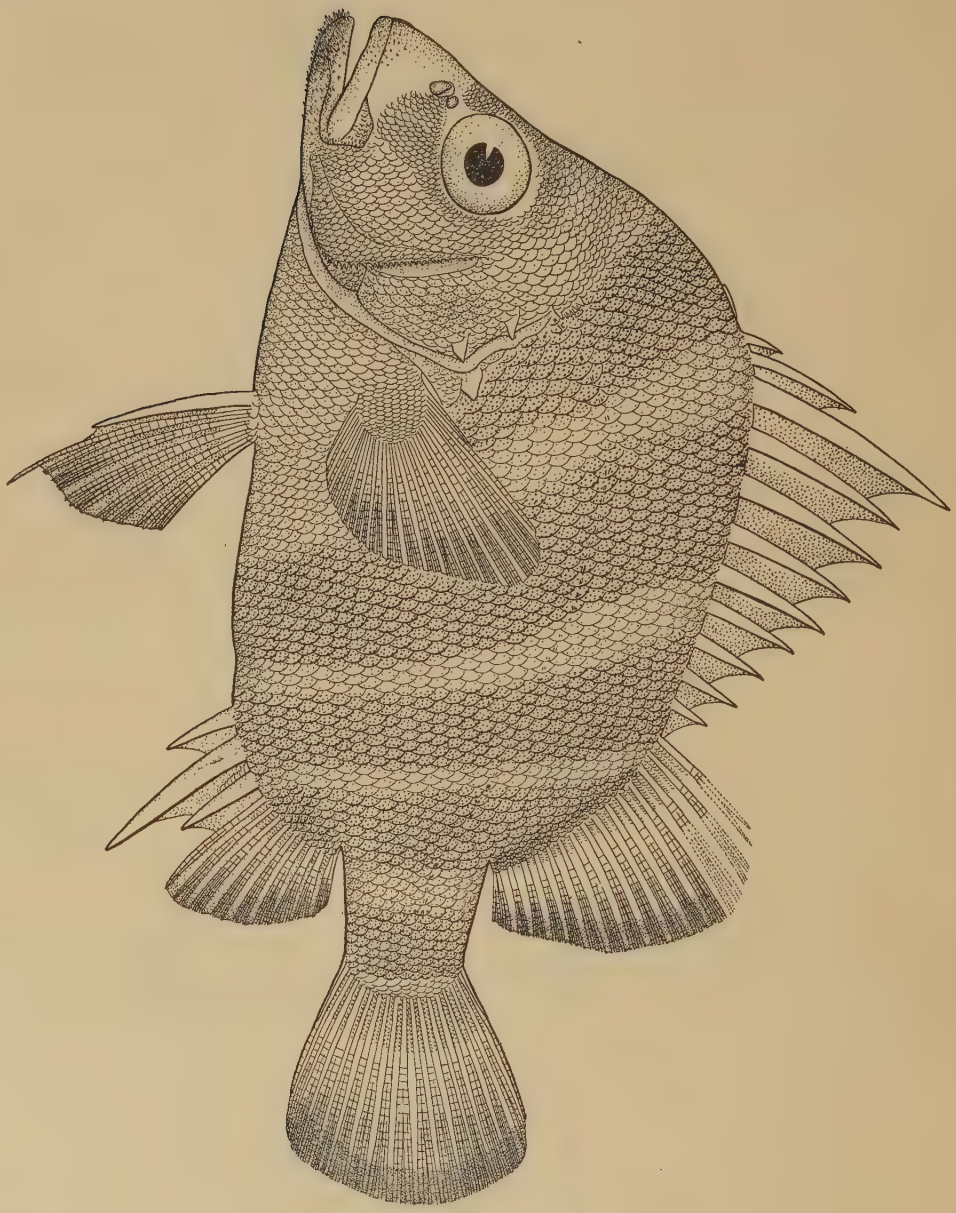

Fig. 7. *Hapalogenys mucronatus* (Eydoux and Souleyet). ×$\frac{2}{3}$.

6. *Hapalogenys mucronatus* (Eydoux and Souleyet).

Japanese Name: Setodai.

Pristipoma mucronatus Eydoux and Souleyet, 1841, p. 161, pl. 2, fig. 2. (Macao, China).
Hapalogenys mucronatus Günther, 1859, p. 318 (China); Ishikawa and Matsuura, 1897, p. 54; Jordan and Thompson, 1912, p. 553 (Kôbe, Onomiti, Hirosima); Jordan and Hubbs, 1925, p. 239 (Osaka market); Tanaka, 1928, p. 883, pl. 181, fig. 495 (Tadanoumi); Fowler, 1931, p. 269 (China, Japan); Schmidt, 1931, p. 66 (Nagasaki, Huzan).
Hapalogenis mucronatus Steindachner and Döderlin, 1883, p. 11 (Osaka).
Hapalogenys analis Richardson, 1846 (a), p. 235 (Sea of China, Canton); Richardson, 1846 (b), p. 85, pl. 43, fig. 3.

Head 2.83 in body length; depth 1.95; orbit 3.33 in head; snout 3.70 (but 2.53 when snout is measured in oblique length); maxillary 2.49; preorbital width 5.17; interorbital space 3.75; first dorsal spine 7.40; second spine 3.84; third spine 1.46; fourth spine 1.90; pectoral 1.55; ventral 1.23; caudal 1.34; second anal spine 1.91; depth of caudal peduncle 2.89. D. XI, 15; A. III, 9; pored scales on lateral line 46, in transverse series from insertion of dorsal to anal fin $^{9}/_{22}$. Gill-rakers on first arch 8+12, the second one on lower limb the longest, 3.83 in orbit.

Body deep and compressed, the upper profile of head not steep, slightly concave before eye, facial angle 55°; ventral profile nearly straight; mouth horizontal; snout blunt, its length slightly shorter than orbit (slightly longer when snout measured in oblique length); maxillary extending to beyond anterior margin of pupil; jaws with villiform teeth, the outer ones enlarged, not canine-like; symphysial notch on upper jaws absent, very slightly present on lower jaw; four pairs of large pores on chin and a slit-like one on throat; barbels of chin very remarkable; nostrils large, much nearer to eye than to tip of snout; orbit very large, longer than horizontal length of snout, and much longer than width of preorbital, 1.5 times of latter; two strong and flat exposed spines present on opercle; humeral spine strong and triangular; posterior margin of preoperculum vertical.

Third dorsal spine much longer and stronger than fourth spine, tenth dorsal spine much shorter than orbit, 1.6 in latter; the outline of spinous dorsal evidently concave from third to last spine; a procumbent spine present before dorsal; ventral long, the outer ray filamentous, its double length reaching to middle portion of caudal peduncle; second anal spine very long; longer than half the length of head.

Scales rather coarse, lacking on snout before nostrils, none on premaxillary,

lower jaw and chin, replaced by papillae, chin strongly papillose; exposed area of maxillary covered with small scales and papillae; minute scales present at bases of soft portion of vertical and minute rows extending along each side of rays one-fifth or one-fourth of the way to their tips and a minute row of scales extending the fronts of the dorsal spines on alternate sides of the membrane.

Color in formalin brownish gray, marked with five dark cross bands; the first from occiput to behind base of pectoral; the second from base of third and seventh dorsal spine to belly; the third from base of ninth dorsal spine and first anal ray to base of anal spines; the fourth from base of third and last dorsal ray to base of soft anal rays; the fifth on caudal peduncle; ventral and spinous dorsal black; soft dorsal, caudal and anal fins margined with black; pectoral clear. Gill-cavity and peritoneum blackish.

Described from a male specimen 208 mm. in total length from Tyôsen; Imperial Fisheries Institute Mus. No. 28.

Except the diameter of orbit and width of preorbital, the proportions of the bodily parts present very slight variations as given in the following table.

TABLE II.

Specimen No.	1	2	3	4
Locality	Tyôsen	Tyôsen	Tyôsen	Tyôsen
Sex	♂	♀	♀	♀
Total length	169.5 mm.	169.2 mm.	172.5 mm.	134.1 mm.
Head in body length	2.81	2.81	2.88	2.81
Depth in body length	2.02	1.92	2.03	1.95
Orbit in head	3.29	3.61	3.23	3.17
Snout in head	3.56	3.46	3.73	2.47
Oblique length of snout in head	2.67	2.69	2.71	2.73

Specimen No.	1	2	3	4
Preorbital width in head	5.16	5.24	5.64	5.31
Second dorsal spine in head	2.67	?	2.54	2.94
Third spine in head	1.19	1.21	1.18	1.23
Fourth spine in head	1.68	1.51	1.56	1.59
Second anal spine in head	1.67	1.94	1.86	1.70
Ventral in head	1.32	1.31	1.24	1.27

This species can be distinguished from the other ones of this genus by the following points: third dorsal spine much longer and stronger than fourth; eye very large, much longer than preorbital width; barbels remarkable; two evident opercular spines present in large specimens; body crossed with five dark bands; soft dorsal, anal and caudal narrowly edged with black and peritoneum blackish.

Habitat.—Southern Japan (north to Osaka) and China, especially abundant in Tyôsen.

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On Pancreatic Protease of Cat-fish.

Takeo Ôya, and Shigeo Yokota.

Our knowledge of protease in Pancreas or in hepato-pancreas of teleosts is very scanty. Ever since a trypsin-like ferment was found by Knauthe (1891–1897) in carp, only three papers have appeared in this connexion. Cheng[1] has worked on protease in the hepato-pancreas of eel (Anguilla japonica). The senior author[2] of the present paper has studied it in the corresponding organ of mackel (Scomber scomber). He has also elucidated jointly with his collaborators[3] the nature of hepato-pancreatic protease of the eel to some extent.

It will not be, therefore, without interest to put on record the observations of the present authors on pancreatic protease as well as on Kinase in the intestinal mucosa of Cat-fish.

Preparation of ferment solutions.

Pancreas and intestinal mucosa of cat-fish, Parasilurus asotus Linne, were treated with acetone and benzine, and were ground into powder. One part by weight of the pancreas-powder was extracted with 10 parts by weight of a glycerine solution (8 parts by volume of glycerine + 2 parts by volume of water). The mucosa-powder was also extracted with the same solvent, the powder being added 1/50 the weight of the fluid. The glycerine extracts thus obtained were centrifuged, and were used as ferment solutions for the following experiments.

Experiment 1.

With a view to investigating whether or not the mucosa extract activates proteolytic enzyme in the pancreas extract, soluble nitrogen to be formed by digestion of casein was estimated in each of the following mixtures:

(1) 0.1c.c. of the pancreas extract + 2c.c. of a phosphate buffer solution + 5c.c. of 2% casein solution + few drops of toluol.

(2) 0.1c.c. of the pancreas extract + 0.1c.c. of the mucosa extract + 2c.c. the phosphate buffer solution + 5c.c. of 2% casein solution + few drops of toluol.

(3) 0.1c.c. of the pancreas extract + 0.1c.c. of boiled mucosa extract + 2c.c. of the phosphate buffer solution + 5c.c. of 2% casein soultion + few drops of toluol.

(4) 0.1c.c. of the mucosa extract+2c.c. of the phosphate buffer solution+5c.c. of 2% casein solution+few drops of toluol.

Each mixture was filled to 10c.c. with water. In the preparation of the second mixture the pancreas and the muscosa extracts were at first mixed and kept at 30°C for half an hour, and then were added the phosphate buffer solution and casein solution. All the mixtures, when prepared, were kept at 30°C for 2 hours, protein being then removed with addition of Na-tungstate and sulfuric acid. Control for each was subjected to the otherwise same treatment. Soluble introgen in each filtrate was thus determined, with the result given in the following table.

Table I.

Mixture No.	Initial pH	Increased-N mg.
1	6.98	3.49
2	„	17.24
3	„	3.74
4	„	1.77

As shown above, the pancreatic protease is considerably activated by the mucosa extract. It follows therefore that the intestinal mucosa of the catfish contains a kinase, and that the pancreatic protease exists in the organ mostly in the form of a zymogen, which is activated by the kinase in the intestinal mucosa, but a little bit as an active ferment.

Experment 2.

The relation between the proteolytic activity and the amount of the mucosa extract was determined by adding various quantities of the mucosa extract to 0.1c.c. of the pancreas extract which was kept at 30°C for half an hour, 5c.c. of a phosphate buffer solution (pH 7.65) and 5c.c. of 5% casein solution being than add and stood at 45°C for a hours. The removal of protein by adding 10c.c. of 20% trichoracetic acid solution to the mixtures led to the estimation the soluble nitrogen increased in 1c.c. of each filtrate. The results obtained are as follows:

TABLE II.

Mixture No.	Pancreas extract	Mucosa extract	Increased amount of soluble-N in of filtrate
1	0.1	0.01	0.209
2	„	0.05	0.515
3	„	0.1	0.618
4	„	0.2	0.824
5	„	0.3	0.824
6	„	0.4	0.824
7	„	0.5	0.824

It will be seen that the activity reaches its maximum in the mixture No. 4. Thus 0.1c.c. of the mucosa extract was used of activating 0.1c.c. of the pancreas extract in following experiments.

EXPERIMENT 3.

For the determination of the optimum pH for the action of pancreatic protease, increased amount of amino-nitrogen was colorimetrically estimated after Folin's method in each of the following mixtures:

0.1c.c. of the pancreas extract, activated by 0.1c.c. of the mucosa extract+5c.c. of 2% casein solution+2c.c. of phosphate buffer solution of different values of pH+2.8c.c. of water.

After two hours' sojourn at 30°C, sodium tungstate and sulfuric acid were added to each of the mixtures, each being filled to 50c.c. with water. The following results obtained are as follows:—

Table III.

Initilal pH	Increased amount of Amino-N in 1c.c. of filtrate mg.
5.91	0.128
6.41	0.160
6.81	0.181
7.15	0.200
7.65	0.222
8.30	0.205

As the above table shows, the optimum pH for pancreatic protease lies at ca. 7.7 and in nearly the same as that for trypsin (pH 7.8～8.5).

Experiment 4.

In order to determine the velocity constant for the pancreatic protease, 10c.c. of 20% trichloracetic acid solution was added to a mixture consisting of 0.2c.c. of activated pancreas extract (0.1c.c. of pancreas extract+0.1c.c. of the mucosa extract)+5c.c. of phosphate buffer solution+5c.c. of 5% casein solution+few drops of toluol, which stood at various temperatures and time, increased soluble nitrogen was estimated as follows:—

Table IV.

Temp. (c)	Time (min.)	Increased solution-N in 1c.c. of filtrate g.
24	60	0.000103
	120	0.000203
	180	0.000292
30	60	0.000172
	120	0.000326
	180	0.000463
45	60	0.000309
	125	0.000549
	180	0.000772

The velocity constant was computed from the above data by using the formula of monomolecular reaction.

TABLE V.

Temp. (c.)	Time (min.)	$k \times 10^4 \times 0.4343$
24	60	4.5
	120	4.6
	180	4.5
30	60	7.7
	120	7.6
	180	7.2
45	60	14.4
	120	14.9
	180	14.5

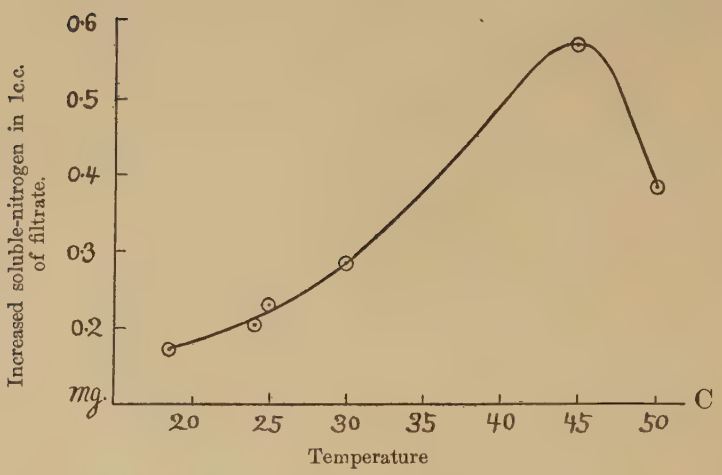
It may be concluded that the action of activated pancreatic protease obeys the formula of monomolecular reaction within 3 hours.

EXPERIMENT 5.

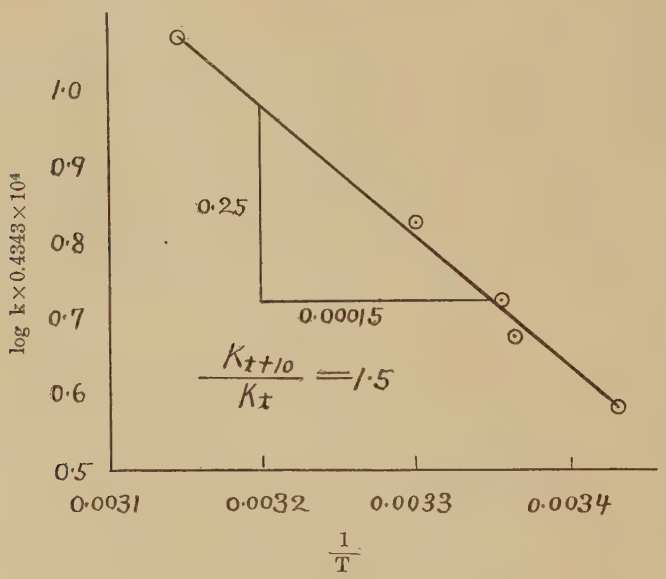
The influence of temperature on the action of pancreatic protease. Soluble nitrogen was estimated under the same experimental condition as that of the experiment 4 and the following results were obtained.

TABLE VI.

Temp. (c	Time (min.)	Increased soluble-N in 1c.c. of filtrate. g.	Velocity constant $k \times 10^4 \times 0.4343$
18.5	120	0.000172	3.84
24	„	0.000207	4.71
25	„	0.000230	5.25
30	„	0.000284	6.62
40	„	0.000567	14.50
50	„	0.000377	9.07



After Arrhenius' formula, I obtained the temperature coefficient as shows in the following figure.



As the above table and figure show, the optimum temperature for the action of pancreatic protease lies at about 45°C and its temperature coefficient is 1.5 at 18.5°~45°C.

Summaries.

1. Pancreas of cat-fish contains a trypsin-like ferment, mostly zymogen, but a little bit as a active ferment, and is activated by the kinase in the intestinal mucosa.

2. The optimum temperature for this protease lies at pH ca. 7.7 nearly the same as that of trypsin, and the optimum temperature lies at about 45°C.

3. The action of this protease obeys the formula of monomelecular reaction within 3 hours under the above experimental condition and the temperature coefficient is 1.5 at 18.5°～45°C.

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